Open File Report OF87-6

Results of a Rock Geochemical Survey of the Lynn Lake Rhyolitic Complex

By M.A.F. Fedikow and K.J. Ferreira

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Winnipeg, 1987

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ABSTRACT

A rock geochemical survey of the Lynn Lake Rhyolitic Complex (LLRC) in the northern belt of the Aphebian Lynn Lake greenstone belt has identified numerous geochemically anomalous alteration zones. Alteration related to (i) three sub-economic massive sulphide-type mineral deposits, (ii) along-strike extensions of the massive sulphide alteration, and (iii) three previously unrecognized geochemically anomalous zones have been delineated utilizing a partial digestion - ICP AAS analytical technique. Major and trace element analyses, based on a hot, partial HCl-HNO_3-H_2O digestion, were both useful in outlining the altered zones. Graphically determined thresholds were utilized for all elements; however, the thresholds determined for Mn and Ti were found to be too low and consequently these elements are ineffective in localizing anomalous Mn and Ti in rocks of the LLRC.

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INTRODUCTION

As part of the development of a mineral deposit data base for the Lynn Lake area, investigations based on a broad range of mineral deposit types and geological environments were commenced in 1982 (Fedikow and Gale, 1982). The Lynn Lake Rhyolitic Complex (LLRC) (Fig. 1) rock geochemical survey was initiated to provide: 1. an indication of the diagnostic chemical elements and compounds and the extent of alteration related to known mineral deposits; 2. an approximation of background concentrations of certain trace elements in felsic volcanic rocks of the LLRC, and; 3. geochemical signatures of previously unknown altered zones.

Rock geochemical surveys of a detailed, local or regional extent have been a significant contribution to the exploration industry by providing geochemical and geostatistical details of mineralized zones and related alteration (Govett, et al., 1975; Govett and Pwa, 1985; Fedikow and Govett, 1985). Drawbacks to the acquisition of these details from a rock geochemical survey of the LLRC are focussed mainly on the availability of outcrop in the LLRC greenstone belt. This problem is attributed to the extensive cover of black spruce bog, till and glaciolacustrinedue to limited exposure throughout the Lynn Lake clays (Glacial Lake Agassiz) in the area. A second serious drawback to the survey is the presence of extensive tailings dumps from the Farley Ni-Cu mine which cover much of the eastern portion of the LLRC and areas of interest. For example, the Y Zn-Cu deposit outcrops as an "island" in a "sea" of tailings and, consequently, rock sampling is restricted to the immediate vicinity of the deposit. Nevertheless, a total of 191 rock samples were acquired from the LLRC. Sample spacing was a function of outcrop availability and was not determined using a predetermined reference grid. Sampling was conducted intermittently over a three month period from June to August, 1982. This open file report discusses the information derived from the survey and also the usefulness of partial digestions for major and trace element analyses during the survey. Survey results are reported in map sheet form, with four contoured elements per sheet, in Figures 3 through 8.

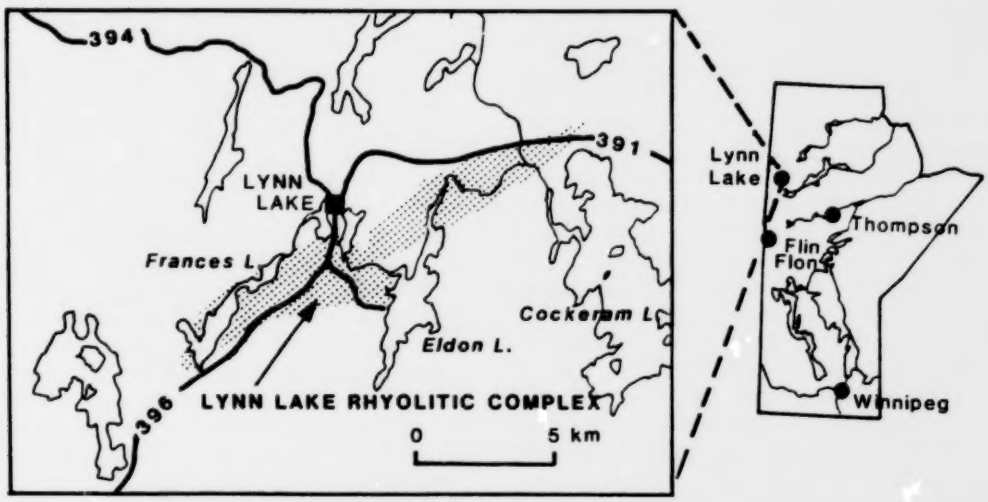

Figure 1: Location map of the study area.

REGIONAL GEOLOGY OF THE LYNN LAKE GREENSTONE BELT

The Lynn Lake greenstone belt comprises variably metamorphosed volcanic, sedimentary and plutonic rocks with an Aphebian age of deposition, intrusion and metamorphism (Clark, 1980; Baldwin et al., 1985). The belt has a 130 km extent from Laurie Lake in the west to McGrath Lake in the east with a maximum width of 60 km. The Lynn Lake greenstone belt is part of a major lithostructural domain that has been called the Lynn Lake Domain (Gilbert et al., 1980) in Manitoba and the Rottenstone-La Ronge magmatic belt (Lewry et al. 1981) in Saskatchewan where the greenstone belt and associated intrusive rocks extend as far as La Ronge (Johnston, 1979). The volcanic and derived sedimentary rocks have been assigned to the Wasekwan Group by Bateman (1945). Wasekwan Group rocks are unconformably overlain by conglomerate and sandstone of the Sickle Group (Norman, 1933). To the south, the Lynn Lake greenstone belt is flanked by the Kisseynew Belt, a sequence of paragneiss, amphibolite and migmatite derived from Aphebian sedimentary and subordinate volcanic rocks (Clark, 1974).

The Wasekwan Group rocks of the Lynn Lake greenstone belt are subdivided into two main structural belts by ovoid tonalite plutons. These are the Northern belt, characterized by mafic volcanic rocks intercalated with lesser felsic and intermediate rock units and the Southern belt, interpreted to contain the oldest rocks in the area. The Southern belt is characterized by greater than 2000 m of aphyric volcanic flows and pyroxene-phyric volcanic flows and breccias.

The Northern belt has been subdivided into stratigraphically ascending components arbitrarily designated A through E. Division A contains pyroclastic rocks and flows of volcanic origin that comprise the LLRC and subordinate mafic to intermediate volcanic rocks and conglomerate; Division B contains high alumina basalt, basalt, andesite and rhyolite; Division C is dominated by turbidite sedimentary rocks; Division D is characterized by high alumina basalt, basalt and high MgO basalt; Division E comprises basaltic tuff and volcanogenic sedimentary rocks. Stratigraphic studies between the two belts indicate the high-alumina basaltic rocks of the Northern belt overlie the Southern belt rocks.

The Wasekwan Group rocks of the Lynn Lake greenstone belt have generally attained middle amphibolite metamorphic conditions although upper greenschist assemblages have been locally identified. Rocks in the vicinity of the Fox Cu-Zn massive sulphide deposit in the west portion of the belt are characterized by upper amphibolite metamorphic mineral assemblages. The petrochemistry of the Lynn Lake greenstone belt has recently been described by Syme (1985). Readers are referred to that publication for major and trace element descriptions and petrogenesis of the major rock units in the belt. The regional geology of the Lynn Lake greenstone belt is depicted in Figure 2.

The Lynn Lake Rhyolitic Complex (LLRC)

The LLRC is a felsic volcanic body 18 km long and 3 km thick that is characterized by lava flows, pyroclastic rocks and minor amphibolite units. Although a detailed stratigraphic study of the entire body has not been undertaken the following description of the general characteristics is given by Baldwin (1983).

Stratigraphic studies within a representative portion of the LLRC indicate the body is composed of approximately 75% pyroclastic rocks. Three separate units have been delineated within the LLRC. The southernmost unit consists of 850 m of plagioclase and quartz-phyric and aphyric tuff, minor pyroclastic breccia, lapilli tuff and some lava flows. The flows are generally less than 40 m thick and are restricted to the upper one-third of the unit. Pyroclastic breccias occur in the lower half of this unit; tuff and lapilli tuff occur throughout. The upper contact of this unit is marked by the sub-economic Zn-Cu Nicoba deposit and possibly the Zn-rich Y massive sulphide deposit. The overlying central unit comprises quartz- and plagioclase-phyric pyroclastic rocks. Tuff is the predominant rock type and along with lapilli tuff forms thin beds. Pyroclastic flows are uncommon but attain thicknesses of 10-15 m and contain vesicular clasts. The northern unit overlies the central unit and comprises 750 m of interbedded tuff, lava flows and amphibolite. Tuffs are aphyric and thin bedded. Lava flows are less abundant than tuff units and are massive, quartz- and feldspar-phyric and contain biotite. Flows occur near the top of the unit. Interlayered uniform- textured amphibolites are considered to represent intrusions. The sub-economic Frances Lake Zn-Cu-Au-Ag massive sulphide deposit occurs within the northern unit of the LLRC.

Within the LLRC all massive sulphide deposits discovered to date appear to be localized at or near the stratigraphic top of a rock unit or sequence. A detailed description of the alteration asssociated with the Nicoba deposit has been prepared by Barham (1985).

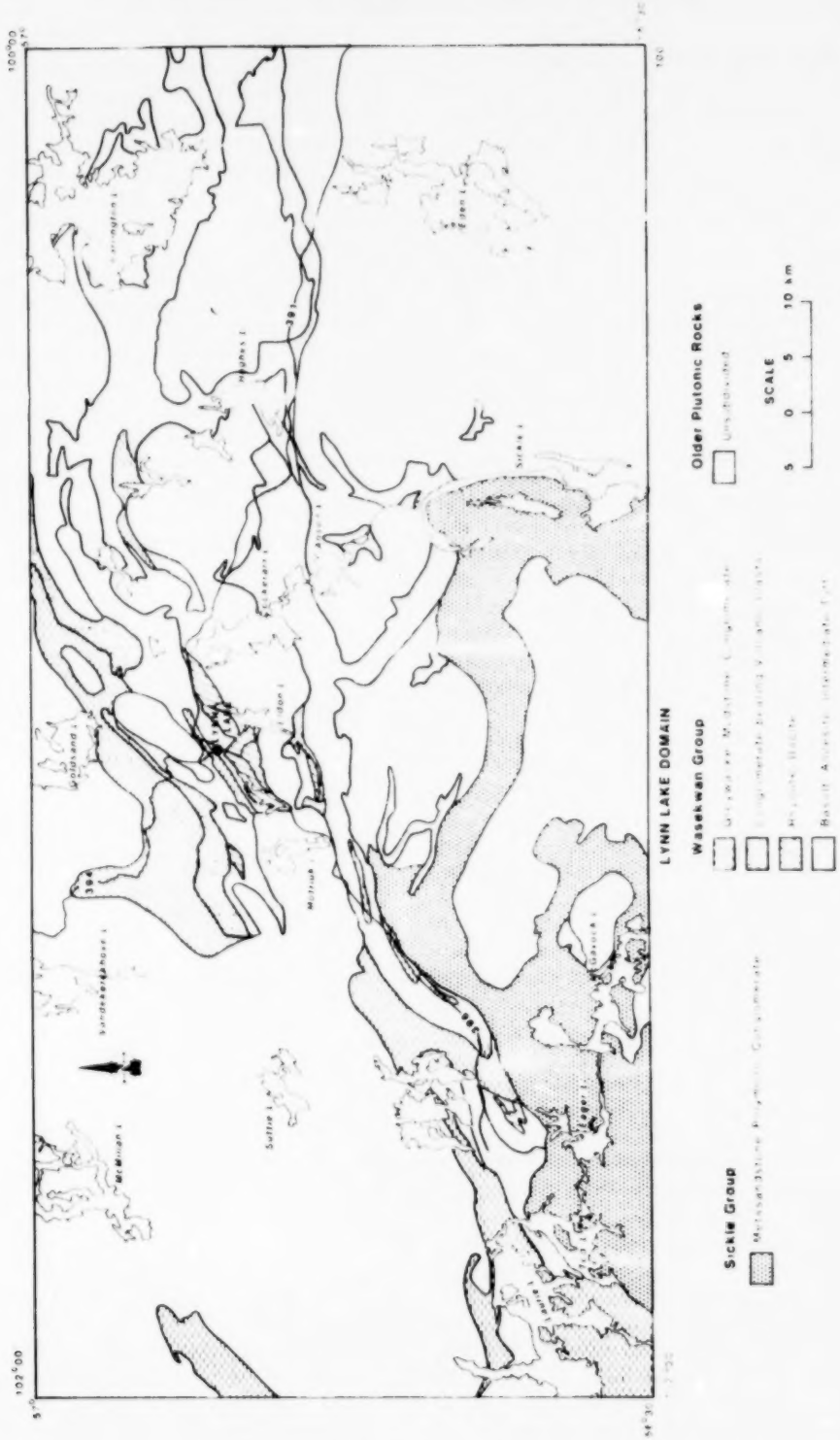

Figure 2. Regional geology of the Lynn Lake greenstone belt.

SAMPLING, SAMPLE PREPARATION AND ANALYSIS

A total of 191 rock samples were collected using a 3 kg sledge hammer. Five representative fist-sized samples were collected from an outcrop area of approximately 25 m^2 and were bulked to give a single sample. Invariably, this method resulted in the mixing of individual pyroclastic and flow units; however, the similarity in chemical composition of these units; the observation that mineralization-related alteration is not confined by stratigraphic boundaries, and the fact that this survey was conducted to define geochemically altered areas or zones and not to assign petrological names to the rocks, indicate the relative unimportance of mixing these rock units during sampling.

Rock samples were crushed in the Geological Services laboratory using a jaw crusher to reduce rock chips to 5 mm diameters and then pulverized to approximately -150 mesh using a Braun grinder. After rolling and quartering about 50 grams of rock powder was placed in clean, pre-labelled glass vials.

Samples were analyzed by Acme Analytical Laboratories Ltd. (Vancouver) utilizing inductively coupled argon plasma after the following sample preparation. A 0.500 g sample was digested with 3 ml of HCl-HNO_3-H_2O in the proportion of 3:1:2 at a temperature of 95°C for one hour. The mixture is made up to 10 ml volume with deionized water. The sample is then analyzed by AAS for Mo, Cu, Pb, Zn, Ag, Ni, Co, Mn*, Fe*, As, U, Au, Th, Sr, Cd, Sb, Bi, V*, Ca*, P*, La, Cr*, Mg*, Ba*, Ti*, B*, Al*, Na*, K*, and W*. The digestion is partial for those elements marked with an asterisk. The lower limits of detection for each element are presented in Appendix I. For future reference all sample locations for this study have been plotted on aerial photographs. These photographs are available for inspection in the offices of the Geological Services Branch in Winnipeg.

Internal laboratory standards included with the LLRC rock samples indicated a ± 18% reproducibility for the elements determined for the study.

RESULTS

Rock geochemical data generated by the multi-element ICP analyses of 191 samples were visually examined for elements falling below the lower limit of detection for the ICP method or for elements that generally showed no change in concentration throughout the sample population. These elements were excluded from the study. Contamination of the sample powders with W and Co from the pulverizing dish resulted in these elements being removed from the data set. Au was not detected utilizing the ICP method; however, the lower limit of detection of 3 ppm is considered to be too high for this survey. The samples will be reanalyzed for Au by instrumental neutron activation analysis (lower limit of detection = 1 ppb) at a later date.

The second stage of data analysis involves generation of descriptive statistics for the data set and determination of the threshold value for each of the 21 elements to be contoured. Threshold selection was undertaken utilizing the graphical method of Tennant and White (1959). The results are given in Table 1.

TABLE 1
Threshold values determined for elements in Figures 3, 4, 5, 6, 7 and 8 after the method of Tennant and White (1959)

ELEMENT	THRESHOLD	FIGURE REFERENCE
K	0.88%)	
Ca	0.48%)	Fig. 3
Al	1.10%)	
Fe	2.10%)	
Mn	500 ppm)	Fig. 4
Mg	0.93%)	
Ti	0.09%)	
Cu	13 ppm)	
As	15 ppm)	Fig. 5
Pb	15 ppm)	
Zn	120 ppm)	
U	6 ppm)	
Th	9.5 ppm)	Fig. 6
V	3 ppm)	
La	52 ppm)	
Ba	100 ppm)	
Sr	9 ppm)	Fig. 7
Bi	3 ppm)	
B	3 ppm)	
Mo	5 ppm)	Fig. 8
Ni	3 ppm)	

Due to the rather steep geochemical gradients observed for some elements, contour intervals for Stage 3 of data analysis were selected at very much higher levels than the threshold to avoid cluttered diagrams. The lowest contour line on the diagrams is equivalent to the threshold value so that all anomalous data on Figures 3 through 8 are patterned.

Contoured geochemical data are discussed with respect to proximity to known mineral deposits and to zones or areas within the LLRC characterized by multiple overlapping geochemical anomalies.

DESCRIPTIVE STATISTICS

Geochemical data for each of 21 chemical elements are presented in Appendix I and a statistical summary for each element is given in Table 2. Histograms are presented in Appendix II.

The skewness and kurtosis statistics in Table 2 and the histograms in Appendix II indicate the generally high positive skew and peaked distribution (kurtosis) for the trace elements. The single exception is Th which has a negative skewness and kurtosis statistic. The strongly skewed and peaked trace element data are explained by the predominance of low concentration levels for many of the trace elements in the data set and the subsequent clustering at the lower concentration levels. This is particularly true for Mo, Cu, Pb, Ag, Ni, U, Cd, Sb, Bi, V, P, Cr, and B although the predominance of low concentrations does not negate the usefulness of these elements in the survey. An occasional high value in the results for these elements (spurious or mineralization related?) will drastically increase the standard deviation or variance for that particular element. In this way a large standard deviation or variance statistic can give an indirect but relevant indication of the presence of a mineralized zone or an area characterized by mineralization-related alteration. The samples with high concentrations of a particular element will not only induce a high variance statistic but will produce a histogram with a positive skew and a cluster of points at the upper end of the concentration scale. Thus, these points represent a second anomalous or discrete population that will induce an inflection in the cumulative frequency diagram and allow the selection or approximation of a threshold value to be used in data contouring. Trace elements related to the mineralizing process and accompanying alteration in the LLRC with the largest observed variance are Mn, Ba, Zn, As and Cu. Particular attention will be paid to these elements in the section describing contoured results and their relationship with the presence of haloes related to known mineral deposits. Major element data for this survey have some similar characteristics to trace elements; however, it is important to note that the major element determinations represent partial analyses because the digestion and resulting

TABLE 2
Statistical summary of rock geochemical data - Lynn Lake Rhyolitic Complex

NOTE: All elements in ppm unless otherwise indicated.

ELEMENT	MIN.	MAX.	ARITHMETIC MEAN	STANDARD DEVIATION	VARIANCE	SKEWNESS	KURTOSIS
Mo	1	6	2	0.9	0.84	0.90	1.23
Cu	1	168	9	17.0	290.71	5.92	44.94
Pb	2	59	7	7.0	46.05	3.57	20.82
Zn	10	972	99	90.0	8068.91	5.71	48.28
Ag	0.1	1.1	0.17	0.1	0.02	3.23	17.33
Ni	1	16	2	2.0	4.37	4.88	26.86
Mn	96	1269	613	198	39046.23	0.47	0.53
Fe (%)	0.84	6.42	2.41	0.9	0.85	1.48	2.45
As	2	400	43	79	6286.00	2.06	3.22
U	5	9	5	0.9	0.73	3.24	0.86
Th	1	14	8	2.5	6.11	-0.44	-0.100
Sr	1	56	7	7.0	50.53	3.72	17.72
Cd	1	4	1	0.2	0.05	13.82	191.00
Sb	2	4	2	0.4	0.16	3.17	9.95
Bi	2	18	3	2	5.02	3.26	14.35
V	1	142	5	15.0	222.70	6.28	45.80
Ca (%)	0.01	1.67	0.25	0.29	0.08	2.68	8.85
P (%)	0.01	0.21	0.03	0.04	0.00	2.77	8.05
La	2	73	30	12.54	157.19	0.14	0.05
Cr	1	38	2	4	17.77	6.51	46.35
Mg (%)	0.13	3.32	0.64	0.43	0.19	2.35	8.69
Ba	8	1083	160	6.0	27447.91	2.62	7.75
Ti (%)	0.03	0.34	0.13	0.06	0.00	0.91	0.38
B	2	12	3.33	2.0	3.78	1.67	2.70
Al (%)	0.34	3.56	1.26	0.59	0.35	1.45	2.14
Na (%)	0.01	0.23	0.05	0.03	0.00	2.73	8.17
K (%)	0.04	2.28	0.77	0.34	0.11	1.37	3.13

analyses probably represent only 15-20% of the total major element content of the rock sample. The digestion is effectively "sulphide-selective" and digests 80-90% of sulphide minerals in the sample powder. Major element distribtions are positively skewed, peaked and compared to trace elements characterized by lower standard deviations and variance statistics (Table 2).

CONTOURED GEOCHEMICAL DATA (FIGS. 3 - 8)

The location of three massive sulphide-type mineral deposits (Y deposit - Zn, Cu; Frances Lake deposit - Zn, Cu; Nicoba deposit - Zn) have been plotted on each of Figures 3 through 8 for comparison with the trends in the contoured geochemical data. The fourth and fifth mineral deposits plotted are the Z (Zn, Cu) deposit and the Gods Lake deposit (Cu, Zn). Neither the Z nor the Gods Lake deposit is hosted by rocks of the LLRC; they may occur in remnants of LLRC stratigraphy enveloped by granitic intrusions. Samples were not collected from the vicinity of those two deposits.

RESULTS

Major and trace element data define geochemical anomalies centered on or in proximity to the three known massive sulphide-type mineral deposits within the LLRC and also delineate a number of other areas or zones with anomalous element contents. Results are discussed with respect to the known mineral occurrences.

(i) Nicoba Deposit (Zn)

A 1700 x 600 m northeast-trending zone of Al enrichment (1.5-3.5% Al) is presented in proximity to the Nicoba deposit (Fig. 3). This zone continues eastward to the northwest shore of Flag Lake and coincides with a north-trending 1200 x 600 m zone of K-enrichment (0.8-2.2% K) that characterizes the rocks northwest of Flag Lake (Fig. 3) but is absent from the Nicoba deposit area. The Nicoba area is also marked by an Fe and Mg enrichment (Fe - 1700 x 600 m, 2.1-6.0%; Mg - 500 x 500 m, 1.0-1.4%; Fig. 4) with variable dimensions. The Mg anomaly appears just south and west of the deposit and also appears at the northwest shore of Flag Lake where the anomaly is characterized by higher Mg contents (1.0-3.0%) and a larger areal extent (1000 x 1000 m). There is a suggestion that the Mg anomaly continues intermittently in a northeast direction from Flag Lake to an area just northwest of a gravel pit. At that location the size (500 m x 250 m) and range in Mg contents (1.0-1.6%) are comparable to the Nicoba Mg anomaly. The areal extent of the Fe ranges from 3.0-6.0%. Sporadic Fe highs can also be traced northeastward to outcrop northwest of a gravel pit. Ba is the only trace element to successfully delineate the Nicoba deposit albeit with a low content anomaly at the deposit (200-300 ppm). The anomaly continues northeastward to the northwest shore of Flag Lake where Ba ranges from 100-1000 ppm and farther east where Ba ranges from 300-500 ppm. Although many trace elements do not delineate the Nicoba deposit the area northeast of the Nicoba and just northwest of Flag Lake is characterized by numerous trace element anomalies accompanying major element anomalies previously discussed. In addition to K and Al (Fig. 3), Fe and Mg (Fig. 4), and Ba (Fig. 7), the northwest Flag Lake area is marked by Bi and B (Fig. 7), and As (Fig. 5) anomalies. Bi (3-15 ppm; 1500 x 1000 m), B (3-10 ppm; 1250 x 500 m) and As (15-400 ppm; 1500 x 1000 m) all form extensive altered zones in this area. It is noteworthy that these anomalies approximate the regional strike of the formations hosting the Nicoba deposit suggesting a possible stratigraphic control to the anomalies. Although the Nicoba is a Zn-rich deposit the element Zn was found to be ineffective in defining mineralization-related alteration at the deposit.

(ii) Frances Lake Deposit (Zn-Cu)

K, Al and Ca (Fig. 3) all form roughly coincident geochemical anomalies south of the deposit extending to the southeast shore of Frances Lake. K (0.8-1.0%; 500 x 250 m) and Al (1.5-2.5%; 500 x 500 m) anomalies also occur south of the Frances Lake deposit but these anomalies may be a continuation of Nicoba alteration. The Ca anomaly in the vicinity of Frances Lake deposit is a composite anomaly with a depleted core of 0.25% (250 x 50 m; 1 sample) rimmed by 0.5-1.25% (700 x 500 m). Unlike the Nicoba deposit, a large number of trace elements form geochemical anomalies, albeit restricted, low sample anomalous populations, in proximity to the Frances Lake deposit. Cu forms a 250 m^2 anomaly with concentrations ranging from 13-40 ppm. The anomaly is not outstanding in terms of extent or its range in concentration when compared with a surprisingly large number of other Cu anomalies depicted in Figure 5. The most impressive of these is centered approximately 750 m north of the Nicoba deposit and 2000 m east of the Frances Lake deposit. This 1000 x 300 m anomaly contains the highest Cu values (13-100 ppm) observed in this study. The anomaly is defined by seven samples as compared to two at the Frances Lake deposit; one to three samples characterize the remainder of the Cu anomalies. Anomalies for U and Th (1 and 2 samples, respectively; Fig. 6), V (1 sample; Fig. 6), and Ni (1 sample; Fig. 8) are observed but are considered to be non-diagnostic of the deposit. This observation is also apparent for Ba and Bi (Fig. 7) although 1700 m south of the deposit a large 750 x 500 m Ba anomaly (100-600 ppm) occurs and may represent the westward extension of the Nicoba alteration.

An extensive Sr enrichment occurs in rocks in proximity to the Frances Lake deposit and extends to the southeast shore of Frances Lake (Fig. 7). The Sr concentration ranges from 7-40 ppm in this 1500 x 1000 m zone and like the Ca anomaly the Sr anomaly gives the impression of being composite with a relatively depleted zone (1 sample only) rimmmed by a more extensive zone of 7-40 ppm.

(iii) Y Deposit (Zn-Cu)

Sampling in the vicinity of the Y deposit was restricted to samples collected from the trenches exposing mineralization and to restricted exposure north of the deposit. Accordingly, the results indicate restricted trace element response to the deposit; major element alteration patterns are absent. A small outcrop area southwest of the deposit is marked by anomalous contents of Fe (3.0-4.0% and Mg (1.0%), (Fig. 4), in the LLRC. The same observation (Fig. 3) is made by Al (1.5-2.5%) in these rocks. With respect to trace elements similar restricted patterns are observed for Cu and As (Fig. 5), and perhaps B (Fig. 7) in outcrop southwest of the deposit. Clearly, restricted sampling in this area has prevented a delineation of the maximum extent of alteration effects in rocks associated with the Y deposit. The observed major and trace element alteration zones southwest of the deposit may be related to the fact that this exposure represents the fringe of alteration in rocks that occur along strike from the Y zone.

(iv) Other Geochemically Anomalous Zones

Outcrops exposed near the northwest shore of Flag Lake are marked by the development of multi-element geochemical anomalies and probably represent the most extensive and intensive alteration delineated in this survey away from known mineralization. This zone has been described in the section dealing with the Nicoba deposit and will not be repeated here. Coincident Cu (13-100 ppm; 1000 x 300 m) and Zn (200-500 ppm; 1000 x 150 m) anomalies (Fig. 5), and Bi (3-15 ppm; 250 x 150 m) and Ba (100 ppm; 200 x 100 m) anomalies mark a second significant altered zone without known associated mineralization, 750 m north of the Nicoba deposit and 2000 m east of the Frances Lake deposit. A third anomalous zone occurs on the southeast shore of West Lynn Lake. This zone is marked by the greatest range of Sr contents observed in the study (7-50 ppm) accompanied by anomalous B (Fig. 7), Th (Fig. 6), Cu (Fig. 3) and in particular As (150-250 ppm; 1000 x 800 m; Fig. 3). Anomalous K (0.9-1.0%), Ca (0.50-0.75%) and Al (1.5-2.5%) occur in these rocks (Fig. 3) as well as Mg (1.0%). Neither megascopic mineralization-related alteration nor alteration of any other affinity was observed during the sampling of outcrops in this area.

(v) Mn and Ti (Fig. 4)

Discussion of the results for these two elements has been purposely omitted until this point. The very narrow range of Ti concentrations in these rocks (0.09-0.30%) and the possible selection of too low a threshold has resulted in large areas or zones within the LLRC designated as "above threshold". Single sample "highs" for Ti occur north of and on the northwest shore of Flag Lake ($<0.30\%$) and south of the Frances Lake deposit ($>0.30\%$). The results for Mn indicate anomalous concentrations associated with the Frances Lake and Y deposits (600 ppm and 600-800 ppm, respectively). The highest Mn occurs on the northwest shore of Flag Lake (1000-1200 ppm) in association with the multi-element geochemical anomalies previously described there. Above the 500 ppm threshold for Mn the range in concentrations is generally small, i.e. 600-1200 ppm. The threshold for Mn has also been selected at too low a level and as a result has delineated broad, areally extensive zones of anomalous Mn concentrations.

SUMMARY AND CONCLUSIONS

This rock geochemical survey is based upon a sulphide selective partial digestion utilized to acquire analyses from 191 samples of the LLRC. This approach is useful in delineating trace element haloes related to the presence of sulphide in an altered zone as well as a major element enrichment (and depletions) developed in the host rocks as a result of the mineralizing process. In this survey major and trace element alteration phenomena centered on and spatially associated with three massive sulphide deposits have been successfully delineated using the partial digestion approach. Additional altered zones, characterized by trace and/or major element enrichments, have been identified. The partial digestion technique represents a cost-effective analytical method applicable to rock geochemical surveys particularly when the bulk silicate whole rock chemistry of the surveyed units is similar, as it is for the felsic volcanic units in the LLRC. Where widely varying lithologies are encountered in a survey area major element differences may reflect only changing lithology rather than a mineralization-related alteration. Under these circumstances the strength of the method would be in trace element determinations; the digestion being sulphide selective and with base metal (and possibly precious metal) enriched pyrite responsible for the observed trace element haloes. The observed alteration phenomena in this survey are generally restricted by the irregular sampling pattern. Nevertheless, alteration zones identified in the vicinity of the northwest shore of Flag Lake, the southeast shore of West Lynn Lake, and a coincident Cu-Zn-Bi-Ba anomaly 2000 m east of the Frances Lake deposit, all merit more detailed geological examination.

In any rock geochemical survey an estimate of average content or background concentration of a particular element becomes critical to data interpretation. A geochemical background need not represent an absolute background, i.e. a total concentration that is arrived at by utilizing a wide variety of analytical techniques (INAA, XRF, AAS), but rather a "most commonly occurring" concentration level. This level may be determined or approximated after any number of analytical approaches as long as the approach is consistent in subsequent surveys. The background may then be stated as a single concentration level or as a range based upon one particular analytical approach. The determination of a threshold bypasses the need for the estimate of background since by definition the threshold represents the upper limit of the background. The accurate determination of threshold then becomes critical if anomaly recognition is to be effective. As was the case for the elements Mn and Ti in this survey, thresholds determined using one graphical solution were too high. This produced areally extensive Mn and Ti anomalies which accomplished little in terms of localizing alteration effects. This does not negate the use of graphical solutions in threshold determinations although it does suggest the need for caution since the distribution of a chemical element in an altered or unaltered rock need not conform to statistical/mathematical laws. In this respect the median or mode may be a less rigorous measurement of the most commonly occurring value, or the background, and can be used to screen out unaltered rocks from bona fide geochemically anomalous sequences.

The following conclusions are evident from this rock geochemical survey:

1. partial sulphide selective digestions are a rapid, cost-effective and useful analytical procedure in an exploration-oriented rock geochemical survey particularly where bulk rock compositions are similar.

2. Alteration phenomena related to three massive sulphide deposits have been identified in this survey.

3. Possible along-strike extensions of the mineralization-related alteration zones and three previously unrecognized geochemically anomalous zones have been delineated using a multi-element (trace and major element) approach.

4. The use of the median or mode of an element for a rock geochemical data set may represent a more effective determination of the most commonly occurring value and a more useful application, in some instances, than a graphically determinated threshold.

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APPENDIX I

ROCK GEOCHEMICAL DATA FOR THE LYNN LAKE RHYOLITIC COMPLEX

Sample Number	Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Mn (ppm)	Fe (%)	As (ppm)	U (ppm)	Th (ppm)
1	1	1	2	62	0.1	1	17	485	1.67	6	5	7
2	2	12	2	102	0.1	2	25	528	2.03	10	5	8
3	2	1	2	61	0.1	1	32	457	1.53	2	5	11
4	3	1	3	55	0.1	1	25	273	1.94	18	5	9
5	2	1	4	54	0.1	1	26	480	1.70	7	5	10
6	1	1	2	45	0.1	3	12	217	0.84	14	5	4
7	3	18	2	77	0.1	1	30	488	1.84	2	6	10
8	2	5	2	87	0.1	1	28	521	1.62	10	5	7
9	3	7	2	87	0.1	1	32	525	1.98	2	5	7
10	3	6	4	42	0.1	2	43	409	1.80	11	5	10
11	2	1	2	66	0.1	13	24	810	3.80	8	5	4
12	3	1	15	89	0.1	1	26	664	1.91	6	5	10
13	2	2	2	46	0.1	2	33	506	1.75	2	5	10
14	3	7	6	90	0.1	1	36	657	1.68	9	5	6
15	4	20	6	150	0.2	16	35	460	2.45	4	5	10
16	5	23	16	190	0.1	13	36	617	2.36	10	5	6
17	2	3	4	104	0.1	2	27	614	1.91	9	6	10
18	2	5	15	95	0.1	2	25	734	2.25	10	5	8
19	2	7	4	112	0.1	3	21	817	2.45	11	6	8
20	4	10	6	111	0.1	3	26	721	2.40	5	5	9
21	3	19	8	54	0.1	1	36	650	2.16	2	5	9
22	2	8	31	56	0.1	1	36	632	2.56	2	9	9
23	2	4	2	77	0.1	1	36	533	1.70	2	9	10
24	1	6	2	119	0.1	2	24	859	2.50	9	5	9
25	2	1	2	57	0.1	1	29	544	1.83	3	5	10
26	3	8	6	105	0.1	1	36	457	1.52	2	5	6
27	2	1	9	43	0.2	2	27	903	2.14	6	6	6
28	2	9	2	60	0.1	3	30	454	1.54	6	5	9
29	2	1	2	57	0.1	1	29	445	1.79	7	6	10
30	2	1	2	36	1.1	1	28	488	1.45	7	9	11
31	4	3	2	77	0.1	2	31	310	2.29	6	6	8
32	4	4	3	57	0.1	2	29	353	1.40	5	6	8
33	4	1	2	84	0.1	1	29	627	1.89	8	5	10
34	1	1	2	59	0.1	2	22	470	1.64	10	6	11
35	1	46	2	79	0.1	5	26	513	5.20	23	5	1
36	2	1	3	58	0.1	1	18	919	1.96	15	5	11
37	1	1	7	198	0.1	1	21	885	2.20	9	5	5
38	2	4	2	96	0.3	1	18	601	1.71	6	5	11
39	1	1	2	40	0.1	1	17	301	1.49	9	5	9
40	2	11	2	20	0.1	1	32	224	1.96	7	5	1
41	1	98	2	48	0.5	3	24	249	2.30	10	5	2
42	2	1	2	85	0.1	1	13	491	1.85	11	5	10
43	1	1	6	66	0.1	1	24	779	1.93	11	5	9
44	2	1	2	89	0.1	1	17	544	1.98	6	5	9
45	3	3	9	79	0.3	1	16	392	1.58	10	5	12
46	4	8	2	107	0.1	1	31	620	2.15	2	5	11
47	3	6	4	53	0.2	1	30	434	1.44	2	5	11
48	2	5	7	80	0.1	1	25	304	1.25	4	5	10
49	1	3	2	165	0.2	1	20	952	3.27	4	6	11

Sample Number	Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Mn (ppm)	Fe (%)	As (ppm)	U (ppm)	Th (ppm)
50	2	10	9	120	0.2	1	25	521	2.01	5	5	9
51	2	1	2	74	0.1	1	27	596	2.30	2	5	10
52	2	1	2	116	0.2	1	29	574	1.97	3	5	11
53	2	1	3	82	0.3	2	29	568	2.46	4	5	11
54	3	2	4	96	0.1	1	17	902	3.18	5	5	8
55	2	2	2	47	0.1	1	27	469	1.59	2	5	11
56	4	2	2	79	0.3	2	27	558	1.82	2	6	12
57	1	2	2	74	0.1	1	24	490	1.77	2	5	10
58	2	2	2	119	0.2	2	28	425	1.73	2	7	12
59	2	2	2	49	0.1	1	28	587	1.52	2	5	9
60	1	2	2	66	0.1	1	21	474	1.62	2	5	10
61	2	4	2	89	0.2	1	27	525	1.93	2	5	9
62	1	1	6	63	0.4	1	16	592	4.02	8	5	6
63	1	1	2	35	0.4	1	16	586	2.87	10	5	6
64	2	15	2	106	0.3	1	27	536	2.12	2	5	6
65	2	12	5	70	0.4	6	36	377	1.46	5	5	6
66	2	4	19	119	0.4	2	23	566	1.29	11	5	6
67	2	4	9	92	0.4	1	19	797	1.71	23	5	8
68	1	1	8	68	0.2	1	17	668	2.40	6	5	7
69	2	2	3	31	0.2	1	28	488	1.68	2	5	7
70	3	6	4	115	0.5	1	20	521	1.82	17	5	13
71	1	25	8	68	0.3	15	27	599	3.61	13	5	6
72	1	3	8	34	0.2	1	12	489	3.51	13	5	5
73	2	3	9	24	0.1	1	33	352	1.89	11	5	8
74	1	5	6	23	0.1	1	18	425	3.62	2	5	5
75	2	4	9	45	0.1	1	17	612	3.76	3	5	4
77	2	6	2	16	0.1	1	21	260	3.33	8	5	5
78	1	20	10	46	0.1	1	26	454	3.75	16	5	8
79	1	3	6	95	0.2	1	24	706	4.40	4	5	3
80	3	19	59	142	0.1	2	34	525	2.99	23	5	7
81	2	5	13	77	0.1	1	31	827	2.69	11	5	6
82	3	24	11	460	0.1	1	33	753	3.56	8	5	4
83	1	6	9	82	0.1	2	30	471	2.88	8	5	6
85	3	3	4	81	0.1	1	39	546	2.08	14	7	13
87	2	5	8	111	0.2	1	30	660	1.96	12	5	8
88	2	3	5	59	0.1	4	30	543	1.99	17	5	9
89	1	7	6	69	0.1	2	34	594	1.93	12	5	12
90	2	5	26	242	0.1	1	25	894	3.12	6	5	8
91	2	3	9	181	0.4	2	23	776	4.12	2	6	8
92	2	2	8	54	0.1	1	33	507	1.96	18	5	11
93	3	1	4	51	0.1	1	41	548	2.22	20	5	11
94	2	4	11	87	0.3	4	29	634	2.53	12	5	12
95	2	6	7	76	0.1	1	24	483	2.19	5	5	8
96	2	11	8	114	0.1	3	36	662	2.11	13	5	7
97	2	9	13	119	0.1	1	34	713	2.34	10	5	10
98	2	7	19	99	0.1	3	27	594	2.06	11	5	9
99	2	9	13	128	0.1	2	31	484	1.98	11	5	11
101	1	53	10	132	0.2	4	36	431	4.52	9	5	2
102	3	10	10	200	0.2	3	24	804	2.69	10	6	10
104	1	17	4	104	0.2	2	21	568	4.95	2	5	4
105	2	6	8	109	0.1	3	29	421	2.77	16	5	11
106	3	3	10	101	0.1	3	32	730	2.24	14	5	9

Sample Number	Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Mn (ppm)	Fe (%)	As (ppm)	U (ppm)	Th (ppm)
107	1	7	15	112	0.3	2	22	337	1.68	14	9	14
108	2	57	11	71	0.2	3	26	403	2.89	9	5	2
501	3	4	12	80	0.1	1	36	653	2.30	11	5	9
502	2	4	7	66	0.2	2	30	573	2.71	14	5	12
503	2	5	5	142	0.1	4	22	1026	3.61	10	5	11
504	2	14	2	53	0.2	2	33	590	1.82	16	5	11
505	2	69	2	75	0.4	1	26	265	1.07	7	5	8
506	3	3	3	113	0.1	1	28	572	2.11	9	6	9
507	2	5	2	66	0.1	1	31	601	1.71	2	5	8
508	2	2	5	94	0.1	1	26	663	2.33	9	5	7
509	2	7	8	123	0.1	1	28	567	1.69	2	5	9
510	1	1	3	69	0.1	1	30	733	2.27	7	5	9
511	3	3	2	81	0.1	1	31	936	2.43	2	5	9
512	2	1	6	153	0.1	1	25	1034	3.36	13	6	9
513	3	2	2	64	0.1	3	25	472	1.76	9	5	8
514	2	12	8	136	0.1	1	26	794	2.25	8	5	10
515	4	168	5	333	0.1	8	33	732	2.55	4	5	8
516	1	1	6	71	0.1	1	20	626	2.52	13	5	10
517	3	1	2	125	0.1	3	27	887	2.46	2	5	8
518	4	73	16	972	0.3	2	32	782	1.94	2	5	9
519	2	8	4	130	0.2	1	30	617	1.92	2	5	9
520	2	1	3	65	0.1	2	28	658	2.08	9	5	10
521	4	2	2	67	0.1	1	33	606	2.07	4	5	10
522	2	1	6	80	0.1	1	24	435	1.58	7	5	6
523	2	9	9	156	0.2	1	23	1015	2.21	9	5	9
524	2	6	12	104	0.2	1	22	714	1.76	8	5	11
525	2	3	4	69	0.1	2	27	580	1.73	6	5	9
526	3	12	10	98	0.1	1	25	680	1.87	7	5	8
527	2	2	2	39	0.1	1	30	339	1.19	4	5	9
528	2	4	2	57	0.1	1	29	628	2.14	4	7	10
529	3	12	40	200	0.1	1	22	533	1.43	6	7	10
530	4	2	5	58	0.1	1	31	615	1.72	3	5	11
531	2	2	3	46	0.2	1	26	488	1.44	4	9	10
532	3	48	10	399	0.3	2	0	890	1.94	3	5	9
533	4	15	11	303	0.3	1	31	632	1.76	8	5	6
534	2	2	2	58	0.2	1	32	555	1.69	7	6	10
535	2	5	2	65	0.1	1	29	535	1.54	9	5	9
536	1	4	2	73	0.1	2	21	261	2.55	8	5	4
537	1	1	21	312	0.5	1	20	628	4.68	16	5	4
538	2	4	14	118	0.1	2	20	592	1.56	15	5	10
539	2	1	2	51	0.1	1	28	527	1.72	2	5	9
540	2	2	2	83	0.1	1	29	696	1.81	4	6	11
541	2	19	2	34	0.1	1	28	453	1.55	270	5	6
542	2	1	16	239	0.2	1	23	400	2.48	220	5	6
543	6	6	5	204	0.1	2	25	701	2.37	236	5	7
544	1	4	7	79	0.1	1	27	656	4.33	171	5	5
545	2	6	15	115	0.1	1	27	475	1.66	255	7	11
546	2	5	5	129	0.1	5	25	789	2.58	213	5	7
547	3	12	8	42	0.1	1	24	685	3.92	167	5	6
548	1	2	8	59	0.5	2	19	778	6.42	115	5	7
549	1	8	14	113	0.1	1	16	714	2.17	146	6	10
550	2	13	3	93	0.1	1	29	832	3.42	220	5	5

Sample Number	Mo (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Ag (ppm)	Ni (ppm)	Co (ppm)	Mn (ppm)	Fe (%)	As (ppm)	U (ppm)	Th (ppm)
551	2	7	2	55	0.1	2	29	648	3.24	237	5	6
552	2	6	10	121	0.1	2	19	525	1.98	180	5	11
554	2	11	10	113	0.1	2	22	640	2.08	192	5	8
555	2	2	4	116	0.1	1	26	787	2.09	237	5	10
556	4	14	10	120	0.1	1	25	733	2.39	236	5	12
557	2	9	13	110	0.1	1	26	651	2.05	228	5	9
558	3	34	6	266	0.1	1	28	605	2.06	266	5	9
559	4	6	4	10	0.1	1	42	96	1.73	400	5	4
560	3	6	8	47	0.2	1	25	531	4.04	203	5	7
561	3	8	8	59	0.1	1	18	526	1.50	167	5	8
562	1	6	10	62	0.1	3	19	875	2.02	166	5	5
563	3	9	9	110	0.1	3	26	626	2.14	226	5	6
564	2	3	2	45	0.1	1	27	350	1.56	257	5	10
565	1	14	4	25	0.4	1	19	331	2.11	172	9	6
566	3	15	15	145	0.1	1	18	1061	5.32	86	5	5
567	1	15	15	128	0.2	1	19	994	5.11	89	5	5
568	2	6	12	58	0.1	1	22	1190	2.98	177	5	5
569	2	4	10	60	0.1	1	18	1171	3.37	149	5	6
570	1	1	11	27	0.1	1	17	323	2.84	148	5	5
571	3	1	11	22	0.4	1	23	945	2.54	196	5	7
572	3	6	13	110	0.2	1	6	659	1.87	54	5	11
573	2	11	10	54	0.1	1	19	733	4.08	147	5	6
574	2	5	5	89	0.1	1	25	1036	3.46	199	5	5
575	1	6	14	107	0.3	1	18	1269	3.10	142	6	9
576	2	7	8	234	0.4	1	29	842	2.38	273	5	8
577	2	16	12	78	0.4	1	29	810	2.82	248	5	6
578	2	7	2	29	0.3	1	23	340	3.87	6	5	7
579	1	5	2	21	0.3	1	27	493	2.96	2	6	8
580	2	8	2	26	0.4	1	25	542	3.50	6	7	7
581	1	12	2	86	0.3	1	21	941	5.13	10	9	8
582	1	4	22	152	0.1	1	23	865	2.09	2	5	8
583	1	6	2	48	0.3	3	23	682	2.86	7	5	7
584	1	5	2	73	0.2	1	22	779	2.90	6	7	8
585	1	6	2	212	0.3	1	24	716	2.93	5	5	7
586	2	1	2	54	0.1	1	20	791	3.29	5	5	5
587	1	6	3	60	0.1	1	23	696	2.98	4	5	6
588	4	4	3	100	0.1	1	20	728	3.21	7	5	5
589	3	5	2	127	0.1	1	18	889	3.35	10	5	5

Sample Number	Sr (ppm)	Cd (ppm)	Sb (ppm)	Bi (ppm)	V (ppm)	Ca (%)	P (%)	La (ppm)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)
1	3	1	2	2	4	0.07	0.01	34	1	0.54	85	0.09
2	10	1	2	2	3	0.38	0.01	34	3	0.39	83	0.09
3	4	1	2	2	1	0.20	0.01	39	1	0.41	66	0.08
4	2	1	2	2	3	0.01	0.01	22	2	0.71	76	0.07
5	4	1	2	2	1	0.25	0.01	37	1	0.37	85	0.08
6	2	1	2	3	4	0.09	0.01	16	1	0.13	45	0.04
7	4	1	2	4	1	0.18	0.01	43	1	0.17	122	0.08
8	13	1	2	2	1	0.96	0.01	26	1	0.27	61	0.08
9	6	1	2	3	2	0.05	0.01	16	3	0.32	87	0.09
10	4	1	2	2	1	0.19	0.01	40	1	0.28	131	0.09
11	4	1	2	2	34	0.15	0.07	25	38	1.65	244	0.21
12	40	1	2	2	2	1.60	0.01	34	1	0.88	66	0.07
13	4	1	2	2	1	0.21	0.01	34	1	0.33	69	0.08
14	9	1	2	2	1	0.57	0.01	23	1	0.31	70	0.07
15	6	1	2	3	1	0.14	0.02	28	1	0.29	58	0.08
16	10	1	2	2	1	0.33	0.02	22	1	0.51	43	0.07
17	4	1	2	5	2	0.21	0.01	35	1	0.41	77	0.09
18	4	1	2	2	5	0.55	0.02	29	1	0.51	168	0.11
19	4	1	2	2	5	0.05	0.02	40	2	0.53	91	0.11
20	3	1	2	2	4	0.04	0.02	73	2	0.44	103	0.11
21	8	1	2	2	2	0.09	0.02	37	5	0.35	113	0.10
22	7	1	3	5	1	0.11	0.01	33	1	0.32	74	0.09
23	7	1	2	4	1	0.10	0.01	41	1	0.27	52	0.08
24	4	1	2	4	5	0.15	0.02	33	1	0.44	116	0.11
25	9	1	2	6	1	0.10	0.01	41	1	0.28	72	0.07
26	6	1	2	2	1	0.33	0.01	27	1	0.25	89	0.06
27	4	1	2	3	1	0.10	0.01	22	1	0.62	185	0.09
28	7	1	2	2	1	0.38	0.01	37	1	0.23	87	0.08
29	6	1	2	5	1	0.32	0.01	36	1	0.24	84	0.08
30	4	1	2	3	1	0.27	0.01	41	1	0.22	80	0.07
31	4	1	2	6	3	0.02	0.01	15	6	0.35	115	0.11
32	3	1	2	5	1	0.08	0.01	29	1	0.40	63	0.07
33	4	1	2	7	1	0.23	0.01	45	1	0.33	74	0.08
34	9	1	3	2	3	0.51	0.01	39	1	0.54	47	0.08
35	11	1	2	2	82	0.46	0.11	7	4	1.57	336	0.34
36	11	1	2	2	4	0.79	0.01	37	1	1.34	74	0.08
37	17	1	2	2	1	1.33	0.01	28	1	0.87	37	0.08
38	2	1	2	3	1	0.07	0.01	12	1	0.97	34	0.07
39	17	1	2	2	1	0.72	0.01	33	1	0.80	33	0.07
40	42	1	2	2	6	1.67	0.11	7	1	0.35	8	0.05
41	11	1	2	4	50	0.89	0.10	10	10	0.69	111	0.09
42	2	1	2	3	1	0.04	0.01	47	1	0.42	49	0.07
43	2	1	2	2	1	0.04	0.01	42	1	0.88	74	0.08
44	2	1	2	2	1	0.06	0.01	54	1	0.60	52	0.08
45	1	1	2	4	1	0.03	0.01	40	1	0.37	47	0.06
46	3	1	2	2	1	0.12	0.01	41	3	0.33	101	0.11
47	6	1	2	2	1	0.30	0.01	42	1	0.27	80	0.07
48	2	1	2	6	1	0.04	0.01	44	1	0.35	70	0.05
49	2	1	2	2	2	0.15	0.05	47	1	0.53	210	0.17
50	5	1	2	2	1	0.34	0.01	33	2	0.34	80	0.10
51	6	1	2	3	1	0.32	0.01	41	3	0.23	111	0.10
52	6	1	4	2	1	0.50	0.01	37	1	0.21	101	0.10

Sample Number	Sr (ppm)	Cd (ppm)	Sb (ppm)	Bi (ppm)	V (ppm)	Ca (%)	P (%)	La (ppm)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)
53	4	1	2	2	1	0.20	0.02	39	3	0.34	97	0.11
54	2	1	2	7	1	0.08	0.04	39	1	0.60	88	0.16
55	7	1	2	2	1	0.46	0.01	38	1	0.20	81	0.07
56	5	1	2	2	1	0.39	0.01	43	1	0.29	107	0.08
57	2	1	2	2	1	0.18	0.01	39	1	0.46	59	0.08
58	7	1	2	2	1	0.22	0.01	35	1	0.19	78	0.08
59	8	1	3	2	1	0.80	0.01	38	1	0.15	84	0.06
60	4	1	2	2	1	0.28	0.01	51	1	0.27	77	0.08
61	7	1	2	2	1	0.42	0.01	32	3	0.25	122	0.09
62	3	1	2	2	2	0.14	0.09	16	1	1.50	333	0.12
63	3	1	2	2	1	0.03	0.02	20	1	0.87	191	0.12
64	5	1	2	2	1	0.11	0.01	28	3	0.37	106	0.07
65	5	1	2	3	9	0.09	0.02	7	29	0.54	144	0.09
66	2	1	2	2	1	0.01	0.01	22	1	0.57	84	0.07
67	2	1	2	4	1	0.02	0.01	13	1	0.84	91	0.07
68	2	1	2	2	1	0.01	0.01	8	1	0.94	152	0.08
69	6	1	2	2	1	0.06	0.01	34	1	0.26	121	0.08
70	3	1	3	2	1	0.05	0.01	17	1	0.55	68	0.08
71	13	1	2	6	78	0.76	0.10	19	31	1.24	393	0.26
72	2	1	2	3	3	0.10	0.06	14	1	1.16	693	0.20
73	6	1	2	2	1	0.07	0.01	32	1	0.46	285	0.11
74	6	1	3	2	19	0.14	0.07	11	1	0.94	612	0.26
75	7	1	2	5	8	0.12	0.06	16	1	0.90	650	0.24
77	7	1	2	2	15	0.15	0.06	25	1	0.71	585	0.18
78	11	1	2	5	142	1.61	0.21	26	1	0.88	483	0.28
79	9	1	2	2	8	0.25	0.08	12	1	0.84	446	0.27
80	30	1	2	2	1	1.21	0.04	27	1	0.44	39	0.08
81	10	1	2	2	2	0.11	0.03	24	1	0.76	437	0.21
82	13	1	2	2	4	0.20	0.06	23	1	0.61	319	0.21
83	16	1	2	2	5	0.31	0.07	21	1	0.48	549	0.18
85	6	1	4	2	1	0.15	0.01	44	1	0.31	111	0.11
87	3	1	3	2	1	0.04	0.01	27	1	0.50	74	0.11
88	3	1	2	2	1	0.02	0.01	33	1	0.64	70	0.09
89	15	1	3	2	1	0.44	0.01	36	1	0.60	86	0.09
90	29	1	2	2	3	0.83	0.03	26	1	0.97	132	0.19
91	3	1	2	4	3	0.06	0.02	24	1	1.45	154	0.15
92	7	1	2	2	1	0.23	0.01	36	1	0.43	106	0.11
93	8	1	2	2	3	0.23	0.03	37	1	0.41	185	0.13
94	3	1	2	2	1	0.15	0.01	33	1	0.63	71	0.11
95	2	1	2	2	2	0.01	0.01	15	1	0.54	66	0.10
96	18	1	2	2	2	0.21	0.02	37	3	0.59	122	0.13
97	8	1	2	2	3	0.13	0.01	31	1	0.49	109	0.12
98	7	1	2	2	3	0.06	0.01	35	1	0.91	127	0.10
99	5	1	2	2	1	0.07	0.01	44	1	0.64	58	0.10
101	8	1	2	3	70	0.68	0.13	19	2	0.79	285	0.15
102	4	1	3	2	5	0.18	0.02	38	2	0.47	160	0.14
104	4	1	2	9	41	0.22	0.12	14	1	1.10	453	0.21
105	20	1	2	4	4	0.39	0.09	23	1	0.99	81	0.06
106	6	1	3	2	1	0.10	0.01	34	1	0.39	98	0.11
107	37	1	3	3	3	0.41	0.01	42	1	0.94	104	0.09
108	13	1	2	3	40	0.85	0.10	12	2	0.81	146	0.07
501	6	1	2	2	1	0.23	0.01	48	1	0.31	97	0.12

Sample Number	Sr (ppm)	Cd (ppm)	Sb (ppm)	Bi (ppm)	V (ppm)	Ca (%)	P (%)	La (ppm)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)
502	8	1	2	2	4	0.24	0.04	43	1	0.29	68	0.16
503	6	1	2	3	7	0.47	0.05	40	2	0.80	166	0.20
504	3	1	2	2	1	0.03	0.01	38	1	0.45	55	0.09
505	1	1	2	2	1	0.01	0.01	2	2	0.25	58	0.10
506	10	1	3	2	1	0.33	0.02	39	2	0.34	86	0.19
507	6	1	2	2	1	0.22	0.02	32	3	0.31	87	0.17
508	4	1	2	2	1	0.03	0.02	19	2	0.45	97	0.20
509	14	1	2	2	1	0.46	0.02	38	3	0.33	94	0.16
510	5	1	3	2	1	0.18	0.02	40	3	0.57	67	0.21
511	3	1	2	2	1	0.07	0.02	44	4	0.87	84	0.21
512	4	1	2	2	3	0.11	0.03	45	9	1.14	100	0.28
513	3	1	2	3	1	0.10	0.01	68	2	0.33	80	0.17
514	6	1	2	2	1	0.13	0.02	44	3	0.71	92	0.20
515	5	1	2	4	1	0.12	0.02	54	1	0.36	101	0.19
516	10	1	2	2	1	0.55	0.03	37	1	0.52	61	0.26
517	4	1	2	3	1	0.15	0.02	48	2	0.59	107	0.22
518	8	4	2	18	1	0.36	0.02	33	1	0.52	127	0.16
519	4	1	2	3	1	0.19	0.02	39	3	0.34	86	0.19
520	6	1	2	2	1	0.23	0.02	38	2	0.47	74	0.19
521	4	1	2	2	1	0.20	0.02	52	2	0.35	82	0.20
522	3	1	2	2	1	0.02	0.01	5	1	0.48	73	0.15
523	8	1	2	2	1	0.31	0.02	35	3	0.42	81	0.21
524	11	1	2	2	1	0.43	0.03	29	1	0.46	60	0.19
525	3	1	2	2	1	0.17	0.01	47	1	0.43	86	0.16
526	3	1	2	4	1	0.02	0.01	58	1	0.56	55	0.15
527	4	1	2	5	1	0.19	0.01	49	1	0.32	69	0.13
528	7	1	2	3	1	0.19	0.02	53	2	0.30	95	0.20
529	7	1	2	2	1	0.12	0.01	40	1	0.51	39	0.11
530	7	1	2	2	1	0.24	0.01	41	1	0.23	91	0.15
531	8	1	2	9	1	0.41	0.01	35	1	0.15	85	0.12
532	4	1	2	5	1	0.15	0.02	35	1	0.33	114	0.20
533	3	1	2	4	1	0.04	0.01	17	1	0.32	74	0.16
534	6	1	2	4	1	0.21	0.01	33	1	0.36	78	0.16
535	10	1	2	6	1	0.43	0.01	34	1	0.28	88	0.15
536	7	1	2	8	3	0.43	0.18	28	1	0.54	312	0.14
537	4	1	2	2	7	0.24	0.16	15	1	1.84	259	0.25
538	7	1	2	4	1	0.17	0.01	37	1	0.58	47	0.15
539	4	1	2	5	1	0.06	0.01	32	1	0.53	62	0.16
540	5	1	2	2	1	0.15	0.01	55	1	0.51	62	0.17
541	4	1	2	2	1	0.07	0.01	27	1	0.49	66	0.07
542	3	1	2	2	1	0.01	0.01	22	1	0.73	193	0.11
543	3	1	2	2	1	0.02	0.01	15	1	0.59	83	0.10
544	5	1	3	7	6	0.22	0.11	23	8	1.52	607	0.27
545	7	1	4	2	1	0.30	0.01	34	3	0.45	43	0.09
546	4	1	2	2	3	0.04	0.01	28	14	0.82	99	0.13
547	8	1	2	8	8	0.18	0.09	27	3	1.57	822	0.22
548	4	1	2	10	1	0.07	0.04	18	8	1.98	359	0.20
549	56	1	2	2	1	0.90	0.01	35	2	0.85	45	0.11
550	8	1	2	2	1	0.29	0.06	22	1	0.52	183	0.23
551	7	1	2	5	1	0.15	0.03	27	3	0.69	260	0.22
552	24	1	2	2	1	0.27	0.01	47	3	1.04	81	0.11
554	18	1	2	2	1	0.54	0.03	23	4	0.61	67	0.14

Sample Number	Sr (ppm)	Cd (ppm)	Sb (ppm)	Bi (ppm)	V (ppm)	Ca (%)	P (%)	La (ppm)	Cr (ppm)	Mg (%)	Ba (ppm)	Ti (%)
555	4	1	3	2	1	0.49	0.01	36	4	0.24	88	0.11
556	16	1	2	2	1	0.48	0.01	37	1	0.61	54	0.12
557	6	1	2	2	1	0.18	0.01	45	2	0.54	86	0.12
558	4	1	2	3	1	0.14	0.01	40	2	0.42	57	0.05
559	3	1	2	2	1	0.02	0.01	6	2	0.44	50	0.03
560	4	1	2	7	1	0.04	0.02	19	1	1.16	198	0.09
561	4	1	2	2	1	0.01	0.01	16	2	0.65	69	0.09
562	4	1	2	3	1	0.03	0.01	26	2	0.70	180	0.11
563	4	1	2	2	1	0.07	0.01	31	2	0.69	107	0.12
564	4	1	2	2	1	0.17	0.01	41	1	0.38	65	0.09
565	6	1	2	4	1	0.03	0.02	12	2	0.85	529	0.11
566	8	1	2	11	9	0.30	0.18	15	3	2.32	627	0.30
567	6	1	2	7	9	0.23	0.14	14	2	1.82	788	0.31
568	7	1	2	2	1	0.14	0.03	25	3	0.81	163	0.20
569	6	1	2	4	1	0.08	0.03	34	1	0.99	246	0.21
570	4	1	2	3	1	0.07	0.03	21	2	0.98	322	0.15
571	4	1	2	6	1	0.04	0.02	17	1	1.06	375	0.17
572	3	1	2	15	1	0.02	0.01	12	2	3.32	105	0.03
573	3	1	2	5	1	0.05	0.03	14	2	1.44	421	0.17
574	4	1	2	3	1	0.07	0.04	23	1	0.80	273	0.18
575	6	1	2	9	1	0.05	0.03	27	1	1.44	259	0.19
576	3	1	2	2	1	0.01	0.01	8	1	0.62	84	0.11
577	10	1	2	3	1	0.14	0.03	23	1	0.70	168	0.18
578	4	1	2	2	1	0.04	0.03	16	1	0.89	93	0.07
579	8	1	2	2	1	0.20	0.03	22	1	0.28	205	0.15
580	4	1	4	2	1	0.05	0.02	9	1	0.62	546	0.17
581	12	1	3	4	7	0.29	0.14	19	3	1.05	1083	0.32
582	4	1	2	2	1	0.05	0.01	35	1	0.63	127	0.09
583	10	1	3	5	1	0.39	0.05	21	1	0.59	156	0.19
584	6	1	2	2	1	0.08	0.03	17	1	0.76	161	0.17
585	15	1	2	2	1	0.22	0.03	23	1	0.31	190	0.16
586	8	1	2	2	1	0.11	0.03	29	1	0.54	161	0.18
587	15	1	3	4	1	0.18	0.03	33	1	0.40	177	0.17
588	2	1	2	2	1	0.04	0.02	15	1	1.41	236	0.13
589	2	1	2	2	1	0.04	0.02	18	1	1.62	389	0.16

Sample Number	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)
1	3	0.89	0.03	0.66	167
2	2	1.01	0.04	0.66	250
3	2	0.81	0.03	0.53	319
4	2	1.06	0.03	0.49	236
5	2	0.76	0.03	0.54	250
6	3	0.34	0.02	0.26	112
7	2	0.71	0.03	0.51	297
8	6	1.25	0.03	0.39	286
9	2	0.76	0.04	0.57	301
10	3	0.77	0.04	0.48	428
11	2	2.29	0.03	1.68	134
12	2	3.04	0.11	0.82	232
13	2	0.64	0.04	0.46	314
14	2	0.71	0.03	0.43	359
15	2	0.68	0.03	0.44	325
16	2	0.85	0.04	0.50	346
17	2	0.84	0.03	0.65	242
18	2	1.05	0.03	0.74	223
19	2	1.11	0.03	0.82	182
20	2	1.02	0.03	0.75	226
21	5	0.89	0.04	0.64	332
22	2	0.84	0.05	0.62	339
23	2	0.56	0.04	0.41	355
24	2	1.06	0.03	0.78	209
25	3	0.50	0.04	0.37	287
26	3	0.60	0.03	0.40	373
27	2	1.04	0.03	0.80	264
28	2	0.62	0.03	0.45	294
29	2	0.74	0.03	0.53	281
30	2	0.56	0.03	0.39	292
31	2	0.91	0.04	0.67	279
32	2	0.71	0.03	0.53	295
33	3	0.87	0.02	0.60	262
34	2	1.28	0.08	0.65	200
35	3	2.39	0.07	1.60	80
36	2	2.73	0.19	1.13	166
37	5	2.86	0.17	1.00	165
38	5	1.34	0.03	0.88	180
39	3	2.04	0.17	0.75	147
40	7	1.62	0.17	0.04	234
41	2	1.16	0.11	0.28	130
42	2	0.87	0.01	0.65	121
43	2	1.21	0.03	0.92	199
44	4	1.06	0.02	0.76	147
45	2	0.81	0.01	0.58	153
46	4	0.92	0.04	0.67	278
47	3	0.71	0.02	0.50	278
48	2	0.70	0.02	0.50	254
49	5	1.37	0.03	1.04	132
50	5	0.88	0.03	0.63	223
51	2	0.91	0.03	0.66	248
52	2	0.83	0.03	0.58	265

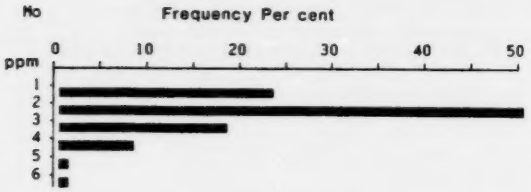
Sample Number	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)
53	2	1.03	0.03	0.75	251
54	2	1.41	0.02	1.06	134
55	2	0.63	0.03	0.45	262
56	2	0.81	0.03	0.57	273
57	4	0.91	0.03	0.67	226
58	3	0.64	0.03	0.46	271
59	2	0.56	0.03	0.40	276
60	5	0.79	0.03	0.53	206
61	5	0.95	0.06	0.66	237
62	2	2.15	0.02	0.89	92
63	2	1.53	0.02	0.87	126
64	2	0.73	0.03	0.51	262
65	2	0.74	0.03	0.57	301
66	2	0.81	0.03	0.60	222
67	2	1.13	0.02	0.81	188
68	2	1.46	0.02	1.02	153
69	2	0.71	0.03	0.52	276
70	2	0.95	0.03	0.70	194
71	2	1.71	0.08	1.06	85
72	2	1.87	0.02	1.30	66
73	12	0.85	0.06	0.63	322
74	4	1.56	0.04	1.31	104
75	7	1.61	0.03	1.25	116
77	3	1.22	0.05	0.89	127
78	2	1.12	0.14	0.63	91
79	2	1.98	0.08	1.44	133
80	3	2.05	0.16	0.45	306
81	2	1.30	0.05	0.99	254
82	2	1.41	0.05	1.03	266
83	2	1.31	0.09	0.74	244
85	3	0.82	0.05	0.63	380
87	3	0.89	0.03	0.74	285
88	2	1.02	0.02	0.83	281
89	3	1.46	0.11	0.80	323
90	4	2.54	0.14	1.24	195
91	2	2.24	0.04	1.11	173
92	2	0.83	0.05	0.66	317
93	2	0.79	0.06	0.58	377
94	2	1.17	0.04	0.93	252
95	2	1.02	0.03	0.82	207
96	2	1.05	0.05	0.68	325
97	3	0.99	0.05	0.78	296
98	2	1.25	0.03	0.88	246
99	2	1.00	0.03	0.78	284
101	2	1.20	0.12	0.56	175
102	6	1.08	0.04	0.85	249
104	2	1.61	0.06	1.19	123
105	2	1.65	0.09	0.25	303
106	2	0.92	0.05	0.73	343
107	2	1.85	0.17	0.75	230
108	2	1.44	0.12	0.14	165
501	2	0.92	0.05	0.67	349

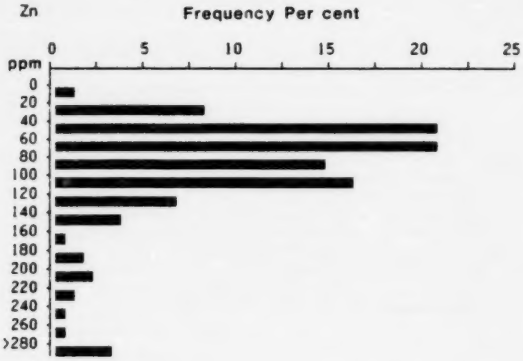
Sample Number	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)
502	2	1.06	0.04	0.74	301
503	2	1.61	0.04	1.26	204
504	2	0.84	0.04	0.66	334
505	6	0.71	0.02	0.49	294
506	6	1.10	0.04	0.69	277
507	5	0.84	0.04	0.57	306
508	8	1.11	0.05	0.78	251
509	5	1.18	0.06	0.58	290
510	7	1.23	0.04	0.79	280
511	2	1.46	0.04	0.96	296
512	4	2.00	0.03	1.38	205
513	4	0.94	0.03	0.62	252
514	4	1.32	0.04	0.90	243
515	4	0.87	0.05	0.57	327
516	9	1.84	0.12	0.87	187
517	4	1.34	0.04	0.89	258
518	5	1.15	0.04	0.72	322
519	6	0.91	0.04	0.60	293
520	2	1.10	0.03	0.75	274
521	9	1.03	0.04	0.70	323
522	4	0.95	0.03	0.63	233
523	7	1.14	0.05	0.68	226
524	3	1.11	0.04	0.59	217
525	5	0.89	0.04	0.63	263
526	4	0.98	0.02	0.71	233
527	5	0.66	0.04	0.45	291
528	5	0.94	0.05	0.67	275
529	2	0.83	0.03	0.50	217
530	4	0.73	0.04	0.50	308
531	2	0.52	0.04	0.36	264
532	2	0.89	0.05	0.59	258
533	2	0.79	0.04	0.52	317
534	2	0.86	0.04	0.58	325
535	4	0.71	0.04	0.51	304
536	2	0.88	0.07	0.40	163
537	5	2.68	0.04	0.99	116
538	3	1.00	0.04	0.63	196
539	5	0.95	0.03	0.65	284
540	2	0.97	0.04	0.68	278
541	6	0.76	0.03	0.49	286
542	2	1.45	0.03	0.93	227
543	4	1.28	0.03	0.91	248
544	10	2.43	0.05	1.74	171
545	4	1.02	0.04	0.66	259
546	9	1.37	0.03	1.06	225
547	2	2.21	0.07	1.43	174
548	6	3.56	0.05	2.13	115
549	2	2.51	0.23	1.02	144
550	7	1.39	0.04	1.00	230
551	3	1.58	0.05	1.12	255
552	2	1.72	0.09	1.09	188
554	3	1.53	0.10	0.85	199

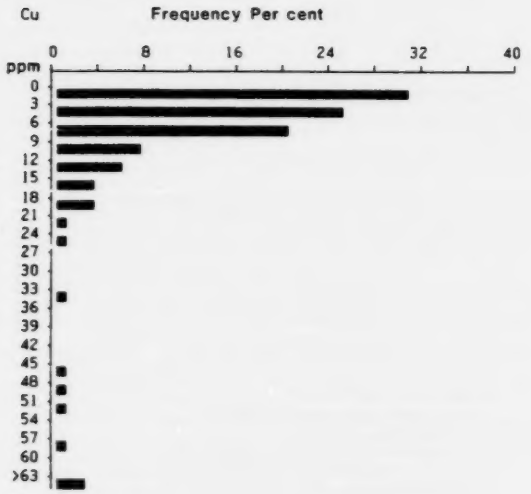
Sample Number	B (ppm)	Al (%)	Na (%)	K (%)	W (ppm)
555	6	0.91	0.04	0.65	246
556	6	1.25	0.04	0.39	250
557	2	1.08	0.04	0.81	243
558	8	0.55	0.04	0.38	271
559	2	0.40	0.04	0.25	415
560	2	2.24	0.04	0.62	209
561	2	0.98	0.04	0.75	170
562	3	1.17	0.04	0.85	171
563	7	1.27	0.05	0.89	242
564	2	0.77	0.04	0.57	269
565	5	1.25	0.04	0.75	172
566	2	3.51	0.09	2.28	79
567	2	2.89	0.06	1.66	94
568	6	1.54	0.04	1.16	186
569	2	1.86	0.04	1.38	158
570	2	1.66	0.03	0.94	151
571	2	1.65	0.03	1.21	202
572	2	2.68	0.03	0.43	47
573	3	2.25	0.04	1.10	146
574	2	1.70	0.03	1.24	208
575	2	2.29	0.05	1.57	145
576	2	1.21	0.03	0.92	287
577	6	1.43	0.06	0.93	260
578	2	1.69	0.03	0.37	209
579	5	1.01	0.05	0.68	250
580	5	1.55	0.05	1.02	217
581	9	2.17	0.05	1.54	126
582	4	1.08	0.04	0.75	241
583	3	1.54	0.08	0.94	207
584	7	1.44	0.04	0.98	205
585	2	1.08	0.04	0.73	234
586	2	1.34	0.04	0.93	185
587	6	1.21	0.04	0.82	219
588	3	2.02	0.03	0.94	196
589	2	2.27	0.05	1.45	160

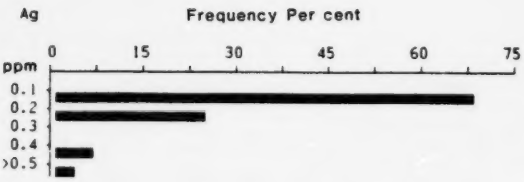
APPENDIX II

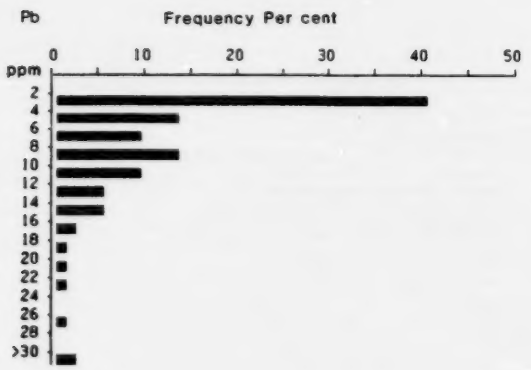
HISTOGRAMS FOR ROCK GEOCHEMICAL DATA FOR THE LYNN LAKE RHYOLITIC COMPLEX

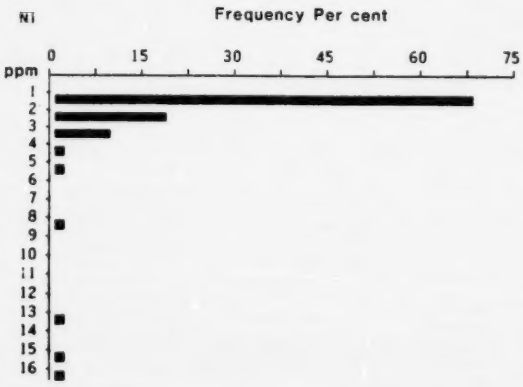


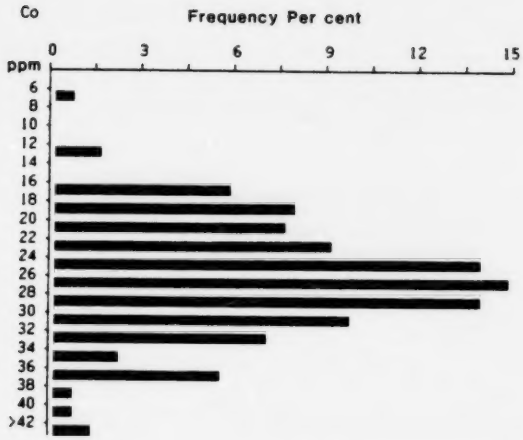


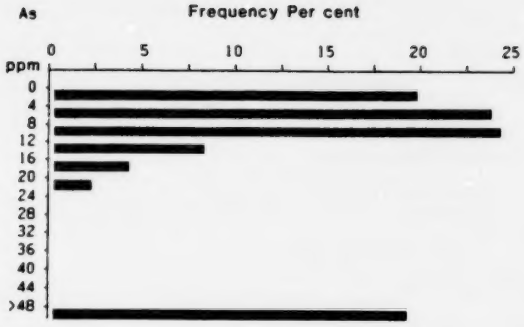


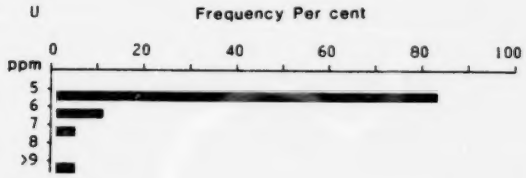


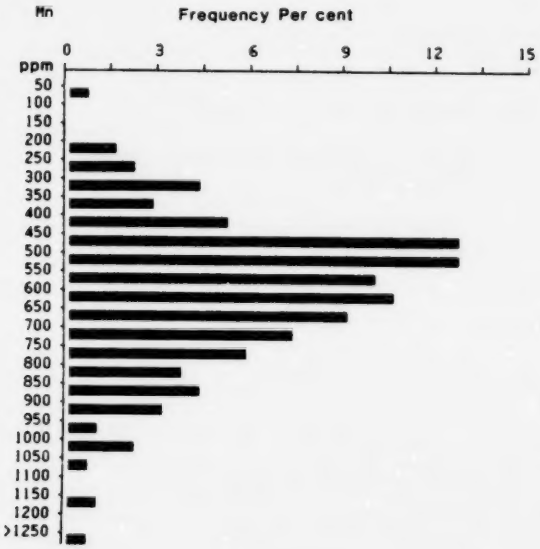


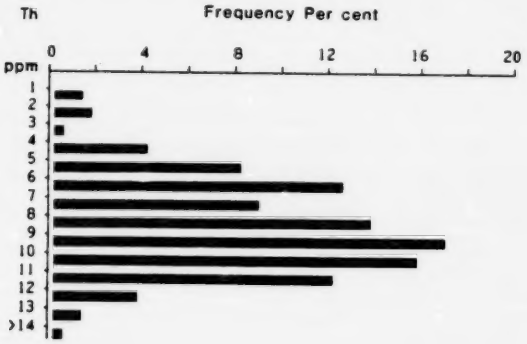


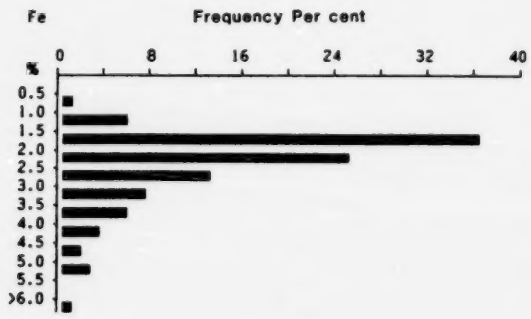

Co
Frequency Per cent
0 3 6 9 12 15
ppm
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 >42

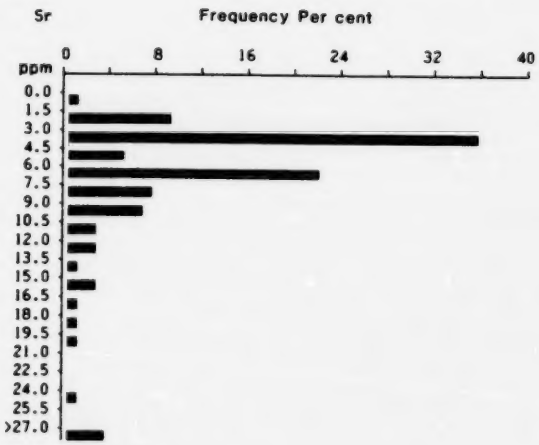

As
Frequency Per cent
0 5 10 15 20 25
ppm
0 4 8 12 16 20 24 28 32 36 40 44 >48

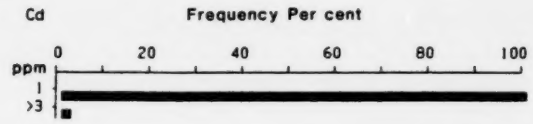

U
Frequency Per cent
0 20 40 60 80 100
ppm
5 6 7 8 >9

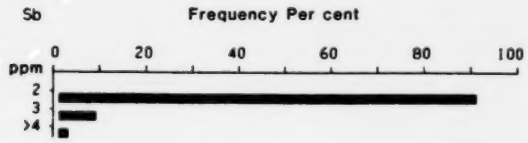

Mn
Frequency Per cent
0 3 6 9 12 15
ppm
50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 >1250

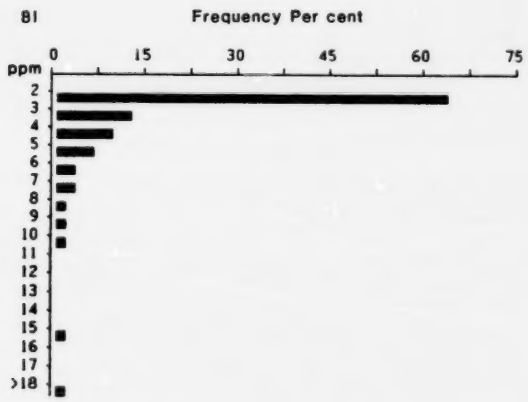

Th
Frequency Per cent
0 4 8 12 16 20
ppm
1 2 3 4 5 6 7 8 9 10 11 12 13 >14

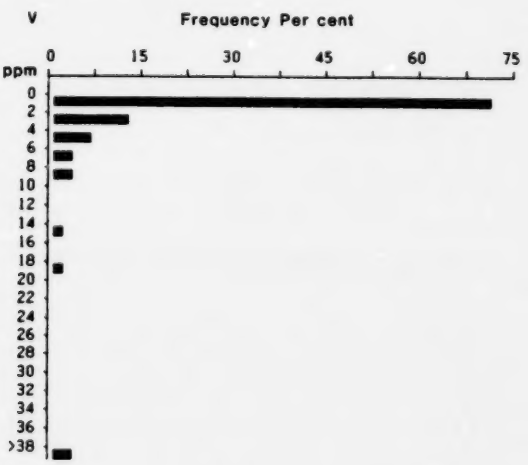

Fe
Frequency Per cent
0 8 16 24 32 40
%
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 >6.0

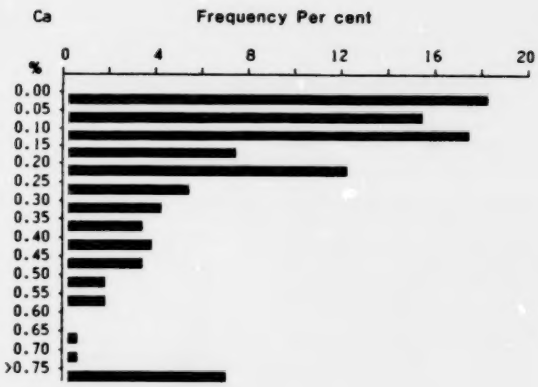

Sr
Frequency Per cent
0 8 16 24 32 40
ppm
0.0 1.5 3.0 4.5 6.0 7.5 9.0 10.5 12.0 13.5 15.0 16.5 18.0 19.5 21.0 22.5 24.0 25.5 >27.0

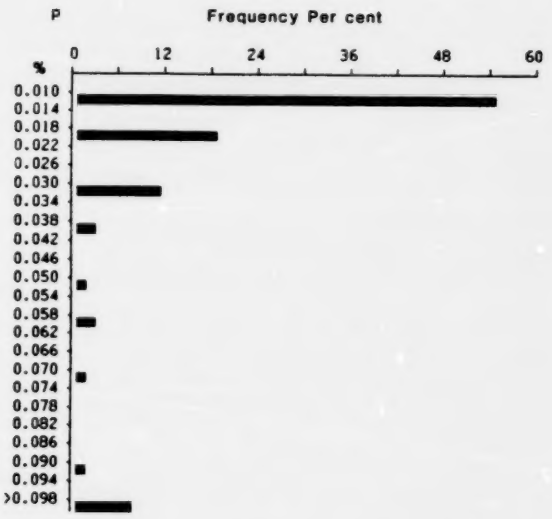

Cd
Frequency Per cent
0
20
40
60
80
100
ppm
1
>3

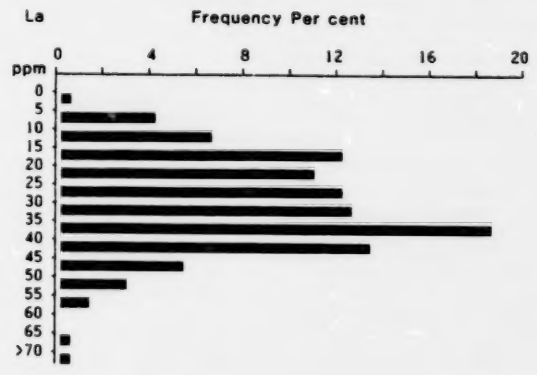

Sb
Frequency Per cent
0
20
40
60
80
100
ppm
2
3
>4

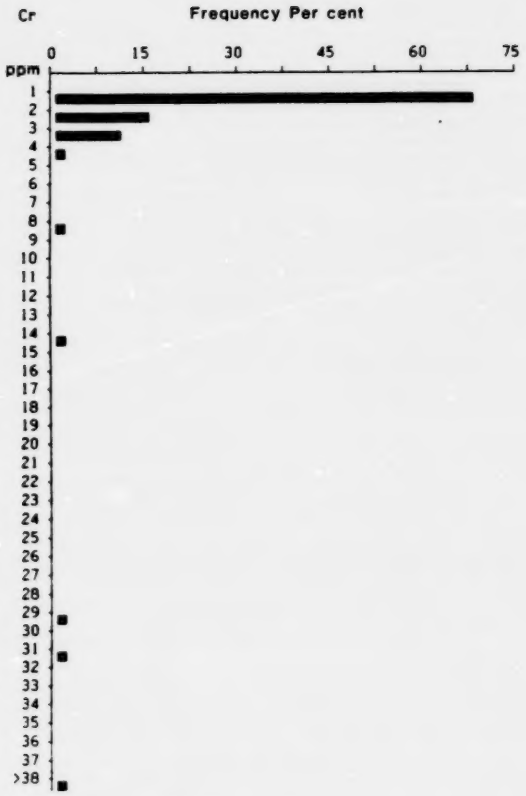

Bi
Frequency Per cent
0
15
30
45
60
75
ppm
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
>18

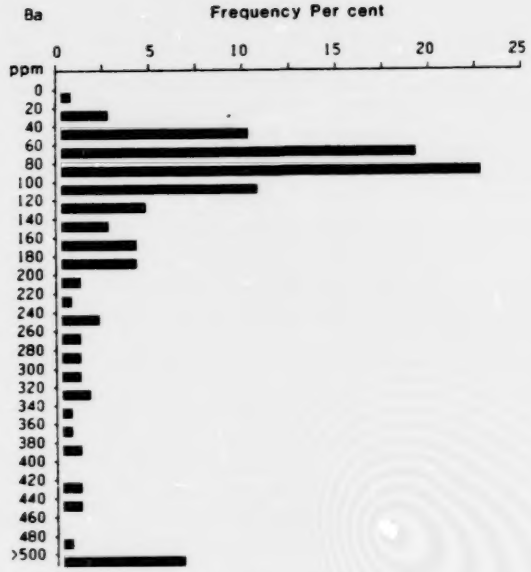

V
Frequency Per cent
0
15
30
45
60
75
ppm
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
>38

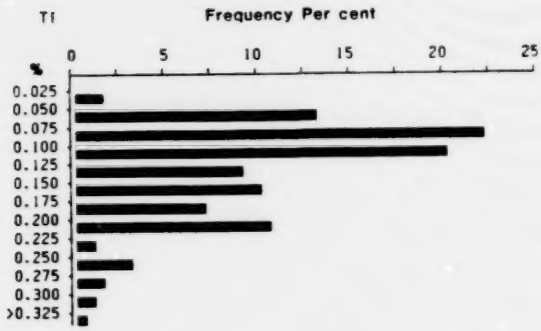

Ca
Frequency Per cent
0
4
8
12
16
20
%
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
>0.75

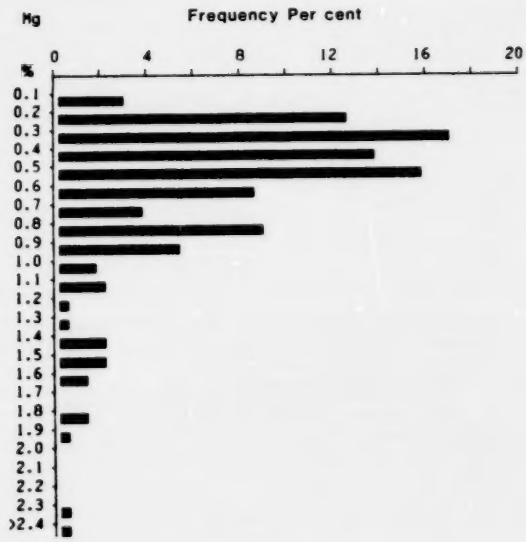

P
Frequency Per cent
0
12
24
36
48
60
%
0.010
0.014
0.018
0.022
0.026
0.030
0.034
0.038
0.042
0.046
0.050
0.054
0.058
0.062
0.066
0.070
0.074
0.078
0.082
0.086
0.090
0.094
>0.098

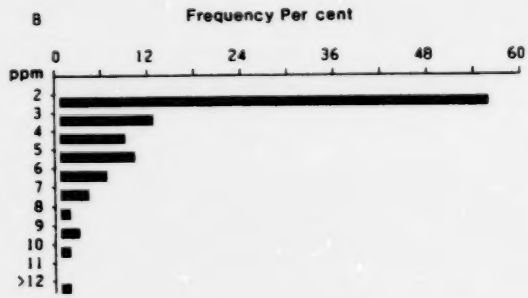

La
Frequency Per cent
0
4
8
12
16
20
ppm
0
5
10
15
20
25
30
35
40
45
50
55
60
65
>70

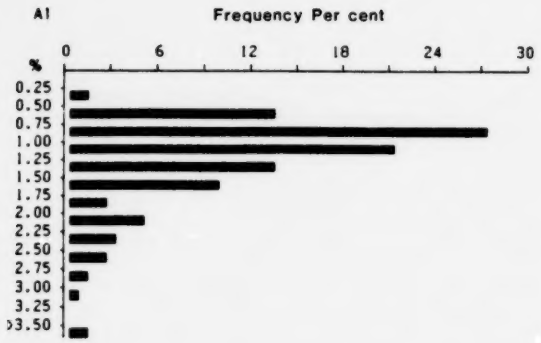

Cr
Frequency Per cent
0 15 30 45 60 75
ppm
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 >38

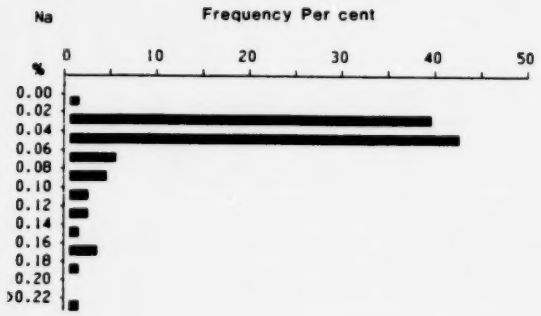

Ba
Frequency Per cent
0 5 10 15 20 25
ppm
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 >500


Tl
Frequency Per cent
0 5 10 15 20 25
%
0.025 0.050 0.075 0.100 0.125 0.150 0.175 0.200 0.225 0.250 0.275 0.300 >0.325


Mg
Frequency Per cent
0 4 8 12 16 20
%
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 >2.4


B
Frequency Per cent
0 12 24 36 48 60
ppm
2 3 4 5 6 7 8 9 10 11 >12


Al
Frequency Per cent
0
6
12
18
24
30
%
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
3.25
>3.50


Na
Frequency Per cent
0
10
20
30
40
50
%
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
>0.22

K
Frequency Per cent
0
3
6
9
12
15
%
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
1.05
1.10
1.15
1.20
1.25
1.30
1.35
1.40
1.45
1.50
1.55
1.60
1.65
1.70
1.75
1.80
1.85
1.90
1.95
>2.00

MAPS
NOT
FILMED

CARTES
OMISES